

Such a molding operation would use a high flow material such as Exxon Escorene Polypropylene PP-1105, or FINA Polypropylene 3824. It is important to gate from both sides and to have very low pack pressure during the molding operation. An undercut on element 16 is preferable in order to secure bearing 18 to element 16. If bearing 18 is molded separately and then secured to element 16, an adhesive can be used in place of the undercut to secure element 16 and bearing 18 together.

An example of a specific molding operation would be to use a 90 Ton Toshiba Injection Molding Machine to mold Exxon Escorene Polypropylene PP-1105. The temperature profile is a 350 F. barrel temperature, a 350 F. rear temperature, a 405 F. front temperature and a 390 F. nozzle temperature. The mold temperature is preferably about 90 F., and a 1/16 inch nozzle should be used. Fill time is 0.25 seconds, screw forward time is 3.75 seconds, injection time is 4.00 seconds and cool time is 15 seconds. Peak hydraulic pressure is 250 psi.

Head 12 is actually made up of a top piece 22 and a bottom piece 24. Both of these pieces are created in separate molding steps with piece 22 being integrally molded with the brush handle. Element 16 is inserted through an aperture 25 in top piece 22 bearing end last to the position shown in the figures. Aperture 25 includes a bearing socket 20 which captures bearing 18. It is preferable to insert a viscous substance, such as some food-grade grease, into socket 20 to provide some resistance to rotation of element 16 to prevent the element from loosely flopping back and forth. Finally, piece 24 is fixed to piece 22 to secure bearing 18 in socket 20. Piece 24 can be secured to piece 22 by, for example, snap features (not shown) or heat welding. Alternatively, piece 24 can be injection molded into place.

An alternative manufacturing method to using two pieces 22, 24 for the head is to injection mold the entire head (and handle) about bearing 18. A higher melting temperature material would need to be used for element 16 and bearing 18 so that they are not softened/melted during injection molding of the head/handle. Element 16 can be exercised after completion of the brush by rotating the element back and forth to free it in the event some plastic from the head is interfering with rotation.

The arrangement described above allows element 16 to rotate back and forth about only one axis 26 which is preferably substantially perpendicular to a long axis of element 16. Preferably, element 16 can rotate about 30 degrees either side of vertical. The top of aperture 25 limits the amount of rotation that can be experienced by element 16. It should be noted that there is no spring force or other force which returns element 16 to a home position, so the element can end up at any one of an infinite number of positions along its 60 degree freedom of movement at the end of the brushing process.

Alternatively, bearing 18 could be made in a spherical shape. Use of such a spherical bearing would still only allow element 16 to rotate about only one axis because, as shown in FIG. 2, head 12 fits up against opposite sides of element 16, thereby restricting rotation to occurring about one axis only.

Turning to FIGS. 4 and 5, an alternative tooth cleaning element will be described. Element 30 includes a tooth

cleaning portion 32 which can be a tuft of bristles or a unitary plastic or rubber fin. A hinge 34 (e.g. a living hinge) made of a soft plastic or elastomer is injection molded onto cleaning portion 32. The material from which hinge 34 is made must be carefully selected, because if it is too soft, retention of element 16 will be poor, and if the material is too hard, the hinge will not be flexible enough. The hinge is preferably made of GLS Corp.'s DYNAFLEX thermoplastic rubber compound G2780 or G2711 and can be injection molded under the conditions outlined above. The living hinge allows cleaning portion 32 to rotate primarily only about an axis 36 which, as described above, is preferably substantially perpendicular to a long axis of portion 32. Resistance to rotation increases as portion 32 is moved away from a position vertical to the top surface of the brush head. A toothbrush head 38 with integral handle (not shown) is injection molded about a base portion of living hinge 34 to capture the living hinge in the head (see FIG. 4).

The invention has been described with reference to a preferred embodiment. However, it will be appreciated that variations and modifications can be effected by a person of ordinary skill in the art without departing from the scope of the invention.

What is claimed is:

1. A toothbrush, comprising;
 - a handle;
 - a head extending from the handle; and
 - a plurality of tufts of bristles extending from the head, each tuft of bristles being supported for rotation about only one axis, each tuft of bristles being rotatable independent of the other tuft(s) of bristles.
2. The toothbrush of claim 1, wherein each tuft has a range of rotation of about 60 degrees.
3. The toothbrush of claim 1, wherein each tuft can rotate about 30 degrees to either side of a vertical position in which the tuft is perpendicular to a top surface of the head.
4. The toothbrush of claim 1, further including at least one tooth cleaning element which cannot be rotated.
5. The toothbrush of claim 1, wherein each tuft includes at its non-brushing end a bearing which is substantially cylindrical in shape in its major portion, each bearing being secured in its own hollow space within the head, each bearing allowing rotation of its respective tuft.
6. The toothbrush of claim 5, wherein the head is made of at least two pieces which are joined together to secure the bearing within the head.
7. The toothbrush of claim 5, wherein a viscous substance is provided in each hollow space in the head to provide some resistance to rotation of the tufts.
8. The toothbrush of claim 1, wherein a portion of the head limits rotation of each tuft.
9. The toothbrush of claim 1, wherein the tufts are rotated by contact with a portion of an oral cavity.
10. The toothbrush of claim 1, wherein each tuft includes at its non-brushing end a living hinge, each living hinge being secured partially within the head, each living hinge allowing rotation of its respective tuft.
11. The toothbrush of claim 1, wherein the axis about which each tuft is rotatable is substantially perpendicular to a long axis of the element.

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